

BLOOM ENERGY CORPORATION
1299 Orleans Dr.
Sunnyvale, CA 94089
Attn: Sean Dunn

**Test Report No: 3847393PP01****Date: 25 September 2015****SAMPLE(S) SUBMITTED**

BY THE CLIENT AS: Bloom Energy Corp., 1A2 open head steel drum, identified as DeS Tucson Steel Canisters, (herein referred to as "Samples"), tested to PG III, as a Design Qualification.

DATE OF RECEIPT: 15 September 2015

TEST PERIOD: 15 – 24 September 2015

TEST(S) REQUESTED: The submitted samples were tested to verify compliance with UN/DOT, IATA, ICAO and IMO Hazardous Materials Distribution and Packaging requirements.

Please be advised that the Samples tested have satisfied the testing requirements and are in conformance with the United Nations/DOT, IATA and IMO packaging regulations, and are eligible to bear the following markings:

 1A2 / Z 103.0 / S / **
USA / +BA1511

This certification is valid for a period of One (1) year from the date of this report. The use of other packaging methods or components may render this report invalid.

SGS NORTH AMERICA INC. IS A CURRENT DOT UN THIRD PARTY CERTIFICATION AGENCY UNDER §107.403

PREPARED BY:

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SIGNED FOR AND ON BEHALF OF
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USA / +BA1511

DeS Tucson Steel Canisters

Table of Contents

Part 1 - Test Summary.....3

Part 2 - Test Product Summary.....3

Part 3 - Packaging Data Sheet
 Section I. Combination Package4-6

Appendices

A. Test Applicability.....7

B. Test Data Sheet
 Section I. Test Parameter Calculations / Derivations – Contents.....8

C. Testing
 Section I. Pre-Test Conditions.....9
 Section II. Test Discussion and Results
 a. Drop Test: See 49 CFR § 178.603.....9-10
 b. Leakproofness Test: See 49 CFR § 178.604.....10
 c1 Hydrostatic Pressure Test: See 49 CFR § 178.605.....10
 c2 Internal Pressure Differential: See 49 CFR § 173.27.....10
 d. Stack Test: See 49 CFR § 178.608.....11
 e. Vibration test: See 49 CFR § 178.608.....11
 f. Compatibility Test: (plastic packagings only).....11
 g. Calculations.....12
 h. Comments / Conclusion.....13
 i. UN/ICAO Report.....14-15

D. References
 Section I. Test Personnel.....16
 Section II. Test References.....16
 Section III. Equipment.....16

E. Additional Information
 Section I. Pictures.....17-18
 Section II. Box / Bottle / Cap Drawings.....19-26
 Section III. Closure Instructions.....27-29

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Part 1 Test Summary^{1, 2}

Tests		Specimen #	Results	#Fail/Total ⁴
a	Drop Test (4 orientations)	1-11	Pass	-
b	Leakproofness test	N/A		
c1	Hydrostatic pressure capability	N/A		
c2	Internal pressure capability	N/A		
e	Stack Test	12-14	Pass	-
f	Vibration standard	12-14	Pass	-
g	Water resistance test	N/A		
h	Compatibility test (liq. In plastics) ³	N/A		

¹ To obtain certification, the sample tested must pass the applicable test for the specific packaging type, intended lading and method of shipment.

² Tests performed, were conducted as per the request of Bloom Energy.

³ Compatibility of the particular plastics inner container and any hazardous liquid lading must be established before use. (*responsibility of the person offering a hazardous material for transportation*; See 49 CFR §173.24(e)).

⁴ See appendix C for details

Part 2 Test Product Summary

Packaging Category: Single Combination Composite

Physical State: liquid Solid Gas aerosol

For Drop Tests:

Solid

Test Product Density:

Density = 1.429 g/cm³

Plastic Pellets and Sand Mixture

Partical Size

Sand = Coarse Play Sand

Poly Pellets = 0.1770" x 0.0750" avg



Photograph 2-1. Simulated load information

Weight of Tested Product: from Box specimen No. 1

- Total weight of filled (95%)container is 103.61 Kg
- Weight of tested product = 103.61 Kg – (box & lid)
- 103.61 kg – 55.5 Kg = 48.1 Kg

Tested Sample (95% fill): Solid The 95% fill mark was calculated as a height using the measured ID of the drum and multiplying by 95%; therefore,

As per client instructions, the simulated load was filled to 39-1/2".

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**Part 3 Packaging Data Sheet
Section I. Combination Package**

PACKAGING DESCRIPTION: Open Head Steel Drum with lid.

UN MARKING(S) PRINTED OR PREVIOUSLY DOCUMENTED: New Design Qualification

OUTER PACKAGING

CONTAINER – STEEL: OPEN HEAD DRUM 1A2

MANUFACTURER	Bloom Energy – 1299 Orleans Dr., Sunnyvale, CA 94089
STYLE	Open Head Steel Drum, straight sided
SIZE BODY	12-1/4" x 43-1/8" (I.D.) 12-5/8" x 44-5/8" (O.D.)
SIZE TOTAL	15-5/8" x 48" (O.D.)
SIZE LID	15-5/8" x 3-1/4"
BODY THICKNESS	0.317" Nominal 0.315" Min
LID CALIPER	0.265" Nominal 0.262" Min
RUBBER GASKET	13-1/4" Dia. 3/8" 28.8 grams
ROLLING HOOPS	Number: 0
SEAM TYPE	Head to body Seam: Welded Flange Side Seam; Welded
IDENTIFICATION	DeS Tucson Steel Canisters
PRINTING	None
CLOSURE	9 M8 Bolts, 9 M8 Flat Washers, 9 M8 Spring Lock Washers, 9 M8 Nuts
CLOSURE	FastGrip 150P Cable Seal - Allied Seals International 105 San Felipe Way Novato, CA 94945
CLOSURE INSTRUCTIONS	The drums were filled to 39.5" from the bottom screen and packed and sealed as per Bloom Energies Filling Instructions per DOC-1005596 REV-A steps 13-15. At no time during transit is the sample pressurized.
TARE DRUM	43.6 kg
TARE LID	6.6 kg
TARE ENTIRE PKG	55.5 kg

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Part 3 Packaging Data Sheet (Continued)
Section I. Combination Package (Continued)

- 1) Welded Screen, Bottom - 1 Required
- Manufacture/Distributor - Bloom Energy – Item # 032746
- Size - 12-5/8" x 1/8"
- Tare Weight - 1,098.30 grams

Placed at the bottom of the body and secured hand tightened with a washer and bolt.

- 2) Welded Screen, Middle - 2 Required
- Manufacture/Distributor - Bloom Energy – Item # 032821
- Size - 12-5/8" x 1/8"
- Tare Weight - 1,111.05 grams

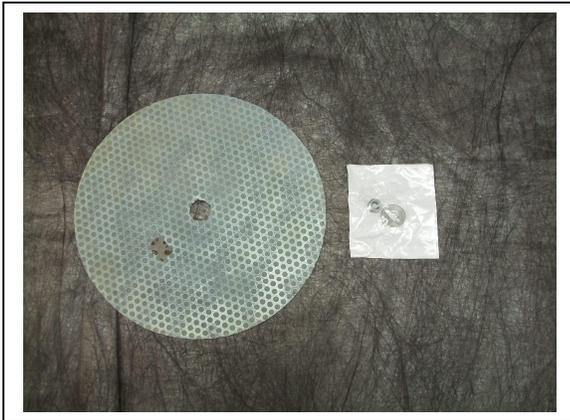
One placed at 39" from the top of the body and the second was placed at 31.5" from the lid.

- 3) Welded Screen, Top - 1 Required
- Manufacture/Distributor - Bloom Energy – Item # 032746
- Size - 12-5/8" x 1-1/8"
- Tare Weight - 1,562.21 grams

Placed at 1-1/2" from the top of the body.

- 4) Springs - 5 Required
- Manufacture/Distributor - Century Spring Corp. – Item # 74
- Size - 12-5/8" x 1/8"
- Tare Weight - 50.46 grams

Each placed in its designated area on detail 3.



Bottom Welded Screen



Poly Bag Fill with Vermiculite

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Appendix A

Test Applicability

Pass / Fail results are based on the actual samples, test loads, and quantities described and submitted for testing. Inferring to other materials, other manufactures, other manufacturing processes, other applications, or different container sizes / capacities is not acceptable.

Reference to material specifications is made based either on the information provided by the requester, the manufacturer, or the markings printed on, attached to, or embossed / molded on the packaging.

Testing was performed per Title 49 Code of Federal Regulations; Subtitle B, Other Regulations; Chapter I, Pipeline and Hazardous Materials Safety Administration (Department of Transportation); Subchapter C, Hazardous Materials Regulations; Part 173, Shippers – General Requirements for Shipments and Packaging; Part 173 Subpart A, General; as well as Part 178, Specifications for Packaging; and Part 178 Subpart M, Testing of Non-Bulk Packaging and Packages.

The required performance tests and standards are intended to evaluate the performance of the packaging components. The criteria used to evaluate packaging performance is whether the contents of the packaging are retained within the primary packaging, should damage to the tertiary packaging occur, and if any packaging is damaged so as to affect safe transportation. The successful completion of the required tests does not ensure the undamaged delivery or survivability of the actual contents.

The successful completion of the recommended performance tests does not, by itself, authorize the marking and transportation of any dangerous good(s). Applicable model regulations should be consulted concerning the relationship of the performance testing completed and the dangerous good(s). Before a configuration can be certified by the person(s) authorizing shipment, the appropriate packaging for the particular hazardous freight and mode of transportation must be determined, and the item(s) must be prepared for shipment per applicable regulations. The chosen configuration must have been performance tested in accordance with the size, the shape, and the weight constraints posed by the configuration to be certified. The testing reported herein should not be constructed as a blanket certification of any configuration that simply uses the performance tested package. Packaging paragraphs apply.

Appendix B
Test Data Sheet

Section I. Test Parameter Calculations / Derivations - Contents

178.602(b)

"For the drop and stacking test, inner and single-unit receptacles other than bags must be filled to not less than 95% of maximum capacity (see § 171.8 of this subchapter) in the case of solids and not less than 98% of maximum in the case of liquids...The material to be transported in the packagings may be replaced by a non-hazardous material..."

§ 178.602(c)

"If the material to be transported is replaced for test purposes by a non-hazardous material, the material used must be of the same or higher specific gravity as the material to be carried, Water may also be used for the liquid drop test under the conditions specified in § 178.603(e) of this subpart..."

Tested Sample (95% fill): Solid The 95% fill mark was calculated as a height using the measured ID of the drum and multiplying by 95%; therefore,
As per client instructions, the simulated load was filled to 39-1/2".

Appendix C

Testing

Section I. Pre Test Conditions

The samples submitted for certification arrived on 6/18/2014. A total number of 14 drums 14 lids were received. After a general inspection was conducted (visual only) it was determined that there was no damage that would adversely affect the testing. Each submitted sample was randomly assigned an identification number in no particular order or sequence.

Pack out instructions for drop testing le: Drums were filled as per client instructions.

For the Drop test, all packagings were conditioned to 73°F for a minimum of 24 hours prior to testing.

PREPARATION OF PACKAGINGS FOR TESTING

The steel open head drum packaging was exposed to a controlled atmosphere maintained at 73° F for 24 hours.

Section II. Test Discussion and Results

a. Drop Test: See 49 CFR § 178.603

Eleven (11) Samples were closed as for shipment and subjected to a free fall drop test from a height of 32.0 inches onto a solid, unyielding steel plate mounted to a concrete floor. The Samples were dropped using a Chain and a quick release so as to fall on specified drum parts as follows:

- Drum 1 - Diagonally on Bottom Elbow.
- Drum 2 - Diagonally on Bottom Elbow.
- Drum 3 - Diagonally on Bottom Elbow.
- Drum 4 - Flat on Side Weld.
- Drum 5 - Flat on Side Weld.
- Drum 6 - Flat on Side Weld.
- Drum 7 - Diagonally on Top, along the weld.
- Drum 8 - Diagonally on Top, along the weld.
- Drum 9 - Diagonally on Top, along the weld.
- Drum 10 - Top Drop
- Drum 11 - Top Drop

In addition to the 6 required drops, 5 additional drop were conducted to verify the robustness of the containers valves/features.

Appendix C (continued)

Testing

Section II. Test Discussion and Results (continued)

a. Drop Test: See 49 CFR § 178.603 (continued)

RESULTS:

Examination of each of the eleven (11) Samples upon completion of the free fall drop test revealed slight deformation but no leakage of product from the Drums. The lid remained firmly affixed to the drum. The valves/features did not cause any leakage. The packaging will continue to provide adequate protection for further handling.

Spec #	Height (in)	Date	Ambient Test Conditions ¹	Orientation	Results ¹
1	32.0"	21 Sept 2015	73° F 50% RH	Diagonally on Bottom Elbow.	Pass - No breakage or leakage; slight deformation at point of impact
2	32.0"	21 Sept 2015	73° F 50% RH	Diagonally on Bottom Elbow.	Pass - No breakage or leakage; slight deformation at point of impact
3	32.0"	21 Sept 2015	73° F 50% RH	Diagonally on Bottom Elbow.	Pass - No breakage or leakage; slight deformation at point of impact
4	32.0"	22 Sept 2015	73° F 50% RH	Flat on Side Weld.	Pass - No breakage or leakage; slight scraping at point of impact.
5	32.0"	22 Sept 2015	73° F 50% RH	Flat on Side Weld.	Pass - No breakage or leakage; slight scraping at point of impact.
6	32.0"	22 Sept 2015	73° F 50% RH	Flat on Side Weld.	Pass - No breakage or leakage; slight scraping at point of impact.
7	32.0"	22 Sept 2015	73° F 50% RH	Diagonally on Top, along the weld.	Pass - No breakage or leakage; slight scraping at point of impact.
8	32.0"	22 Sept 2015	73° F 50% RH	Diagonally on Top, along the weld.	Pass - No breakage or leakage; slight scraping at point of impact.
9	32.0"	23 Sept 2015	73° F 50% RH	Diagonally on Top, along the weld.	Pass - No breakage or leakage; slight scraping at point of impact.
10	32.0"	23 Sept 2015	73° F 50% RH	Top Drop	Pass - No breakage or leakage; slight deformation at point of impact.
11	32.0"	23 Sept 2015	73° F 50% RH	Top Drop	Pass - No breakage or leakage; slight deformation at point of impact.

¹ All samples were conditioned to 23°C (73°F) (per CFR 178.603(c)(1), for metals) prior to testing for a minimum of 24 hours.

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Appendix C (continued)**Testing****Section II. Test Discussion and Results (continued)****d. Stack Test:** See 49 CFR § 178.606

Three Samples were closed as for shipment and subjected to a static compression test under a load equivalent to a 10-foot high stack of identical packages. The load applied to the top surface of the Samples was calculated to be 340 pounds.

The static compression load was allowed to stand for 24 hours at ambient conditions.

RESULTS:

Examination of each of the three (3) Samples throughout the stacking test period did not reveal any leakage from the seams or closures that could adversely affect transport safety. The stacking stability of the Samples remained unchanged throughout the 24-hour stacking period.

e. Vibration Test: See 49 CFR § 178.608

Three (3) Samples were placed on the table of a rotary vibration tester and vibrated at an acceleration of 1G+ for a period of 60 minutes at 235 cycles per minute.

RESULTS:

Examination of each of the three (3) Samples throughout the stacking test period did not reveal any leakage from the seams or closures that could adversely affect transport safety.

f. Compatibility Testing - Responsibility of the person offering a hazardous material for transportation; See 49 CFR §173.24(e). Not tested.

Appendix C (continued)

Testing

Section II. Test Discussion and Results (continued)

h. CALCULATIONS

$$\text{Stacking Load, lbs} = ((120 / H) - 1) \times (GM \times 2.2)$$

where

120 = Stacking Height, inches
 H = Package Height, inches
 GM = Gross Mass, Kg (Mark)

Gross Weight	103.0
Package Height	48.0
Applied Load, Lbs	340

Drop Height, Inches

PG I (X) = SG x 4.9 x 12
PG II (Y) = SG x 3.3 x 12
PG III (Z) = SG x 2.2 x 12

where

SG = Specific Gravity, g/mL

X	71.0
Y	48.0
Z	32.0

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Appendix C (continued)

Testing

Section II. Test Discussion and Results (continued)

i. COMMENTS

- ◆ The filled and closed Samples were found to satisfy the drop, stacking and vibration test requirements and would provide adequate protection for further handling.
- ◆ The appropriate United Nations marking for the open head drum box should be (Revised)

u
n
 1A2 / Z 103.0 / S / **
 USA / +BA1511

1A2	-	Packaging Type Code
Z	-	Packaging Group
103.0	-	Gross Mass (kg)
S	-	Solid (inner packaging)
**	-	Year of Manufacture
USA	-	Country Where Testing Performed
+BA1511	-	3 rd Party Testing Agency & Test No.

It should be noted that the packages **must** be imprinted with the appropriate proper shipping name, hazard class and product identification number. It is the shipper's responsibility to ensure that all applicable regulations are followed, and that the packaging design type is adequate to type of material to be carried and the mode of transportation used. The +BA mark may not be used by any other third party laboratory recertifying this package.

CONCLUSION

Based upon the above results, the test Samples have satisfied the requirements of Section 6 of the United Nations Recommendations on the Transport of Dangerous Goods Model Regulations and the DOT, IATA, ICAO and IMO packaging specifications and performance tests.

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Appendix C (continued)

Testing

Section II. Test Discussion and Results (continued)

j. UN/ICAO CERTIFICATION REPORT

SGS North America INC.291 Fairfield Avenue Fairfield, NJ 07004
Phone: (973) 575-5252 Fax: (973) 575-8271**Lab ID:** +BA **Report No.:** 3847393PP01 **Certification No.:** 1511 **Expiration Date:** 25 September 2016**Package Identification:** DeS Tucson Steel Canisters **Date Tested:** 15 – 24 September 2015**Company:** Bloom Energy Corp.**Address:** 1299 Orleans Drive **City:** Sunnyvale **State:** CA **Zip:** 94089

Description of Packaging

Packaging Type Code: 1A2 **Packaging Nomenclature:** Open Head Steel Drum, Straight Body**Size (OD):** 15-5/8" x 48" OD

Open Head Steel Drum with lid.

Testing Environment

Temperature: 73° F **RH:** 50%

Appendix C (continued)

Testing

Section II. Test Discussion and Results (continued)

TEST PROCEDURES

Drop Test: Pass: X Fail:

No. of Samples: 6 Drop Height: 32.0" Packaging Group: Z

Stacking Test: Pass: X Fail:

No. of Samples: 3 Load: 340 Duration: 24 Hrs.

Vibration Test: Pass: X Fail:

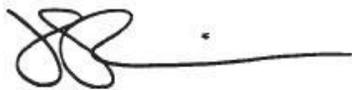
No. of Samples: 3 Frequency: 178 CPM Duration: 60 Min.

RESULTS AND COMMENTS

The test samples submitted have satisfied the requirements of the UN/DOT, IATA and IMO Transportation of Dangerous Goods Regulations and are authorized to bear the following markings:


 1A2 / Z 103.0 / S / **
 USA / +BA1511

I certify that the samples were tested in accordance with applicable procedures as set forth in the United Nations Recommendations of the Committee of Experts on the Transportation of Dangerous Goods Model Regulations, Chapter 6, and that the results are true and valid for the material tendered.



Jason Sherrier, CPLP
Laboratory Manager, Packaging and Materials
SGS North America Inc.

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Appendix D

References

Section I. Test Personnel

The following personnel performed the following tasks:

Nikolaus Irkiewskij - Testing
 Jason Sherrier - Supervised Testing / Issued Certification Report

Section II. Test References

- a. **Title 49 Code of Federal Regulations, Parts 106-180, (current as of March 1, 2015)**
- b. **ASTM D 4919**, Standard Guide for Testing of Hazardous Materials Packagings
- c. **ASTM D 5276**, Standard Test Method for Drop Test of Loaded Containers by Free Fall
- d. **ASTM D 4332**, Standard Practice for Conditioning Containers, Packages, or Packing Components for Testing.

Section III. Equipment

Item	Manufacturer	Serial No.	Calibration Date
50,000 Compression Machine	Lansmont	152-50-13880	1-July-2015
Temp / Hum Chart Recorder	Extech	07150222	8-Jan-2015
Vibration Table	L.A.B.	241180	22-Apr-2015
Balance	Satorious	13602762	14-Oct-2014

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Appendix E
Additional Information

Section I. Pictures



Packout Picture

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Appendix E (continued)

Additional Information

Section I. Pictures (continued)



Vibration Test
(One shown, three tested)



Stacking Test

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Appendix E (continued)

Additional Information

Section I. Pictures (continued)



Drop Test

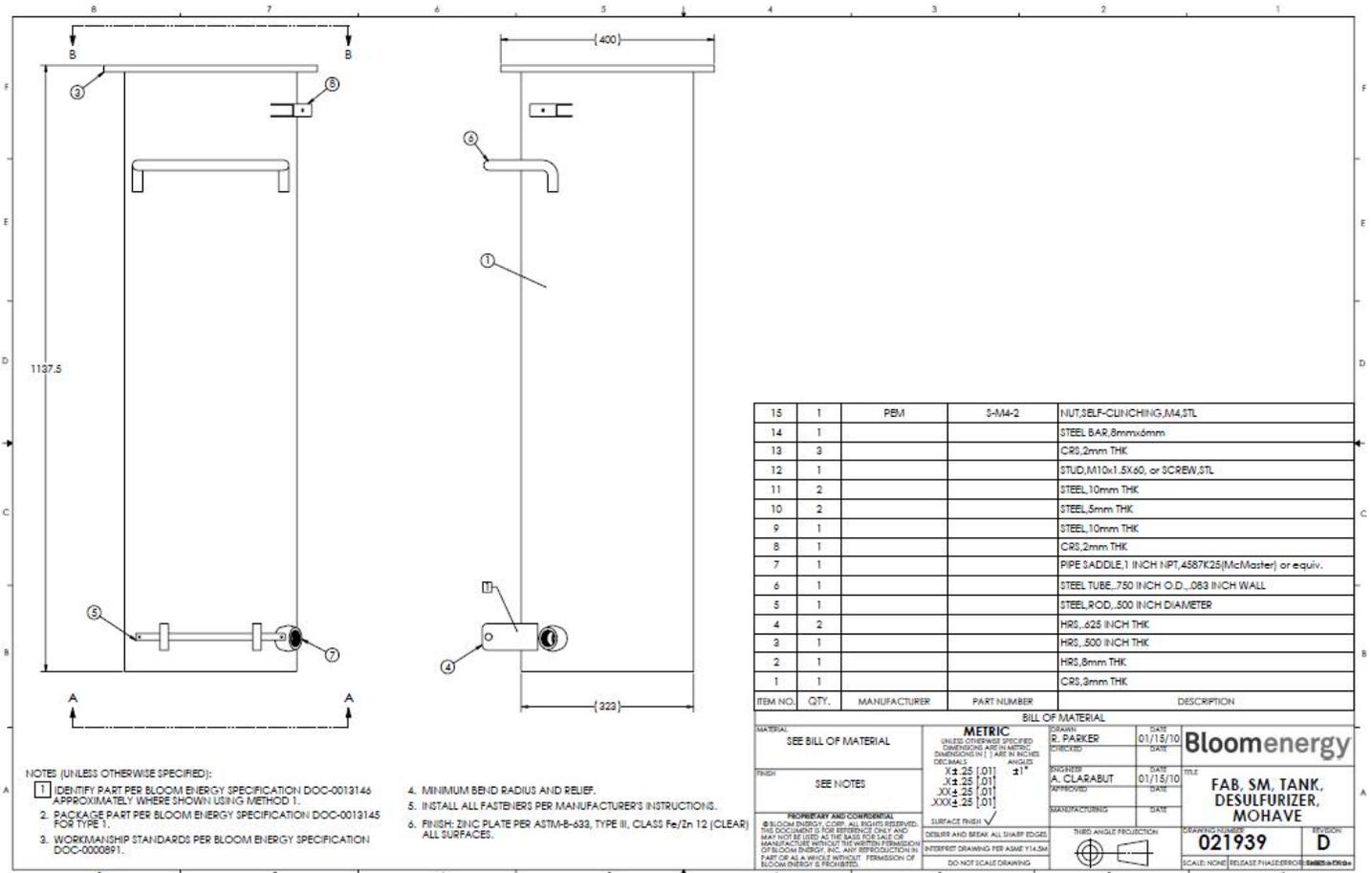
(Four Shown, Eleven Dropped)

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Appendix E

Additional Information

Section II. Box / Bottle / Cap – Pictures/Drawings

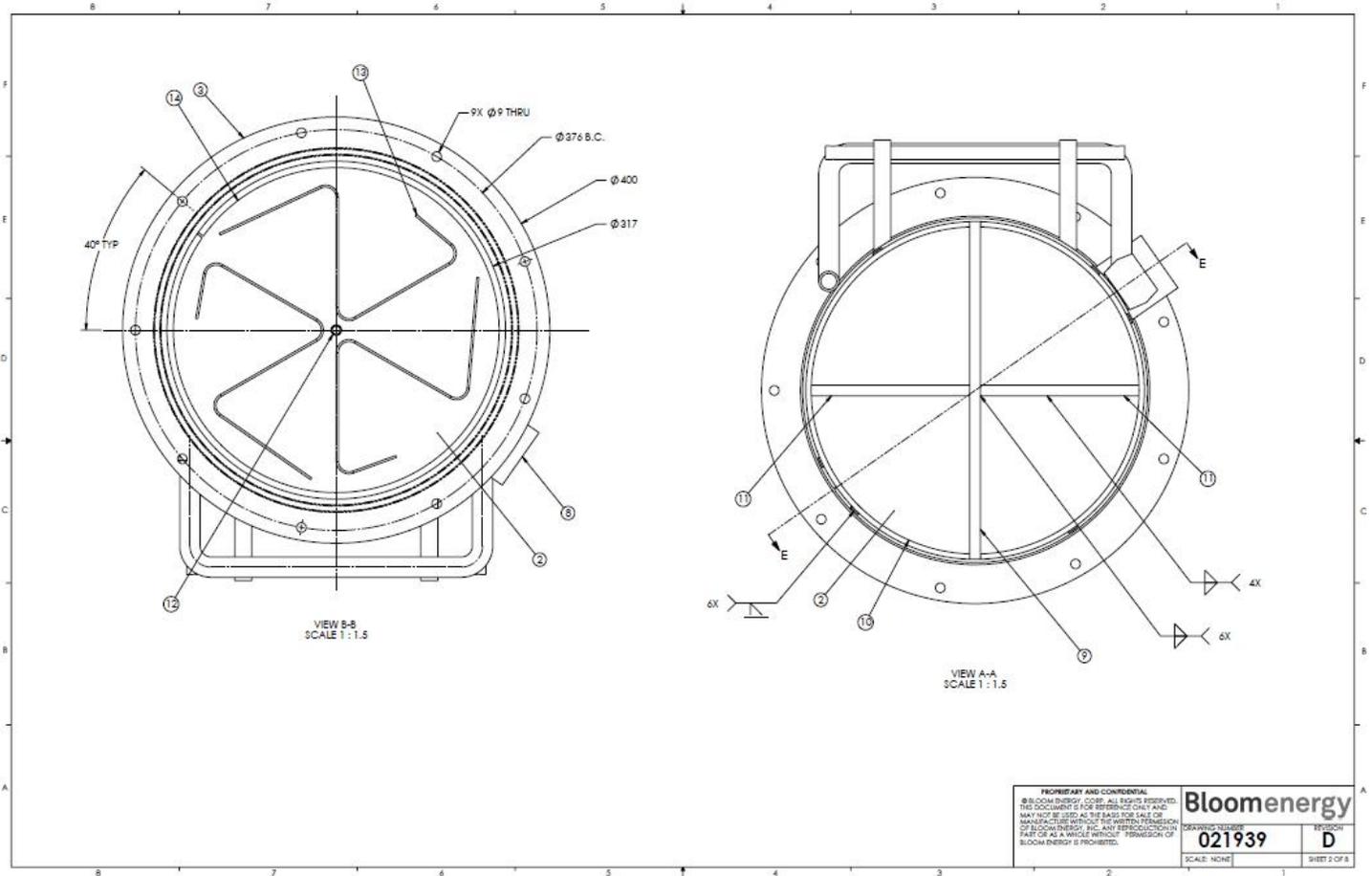


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Appendix E

Additional Information

Section II. Box / Bottle / Cap – Pictures/Drawings

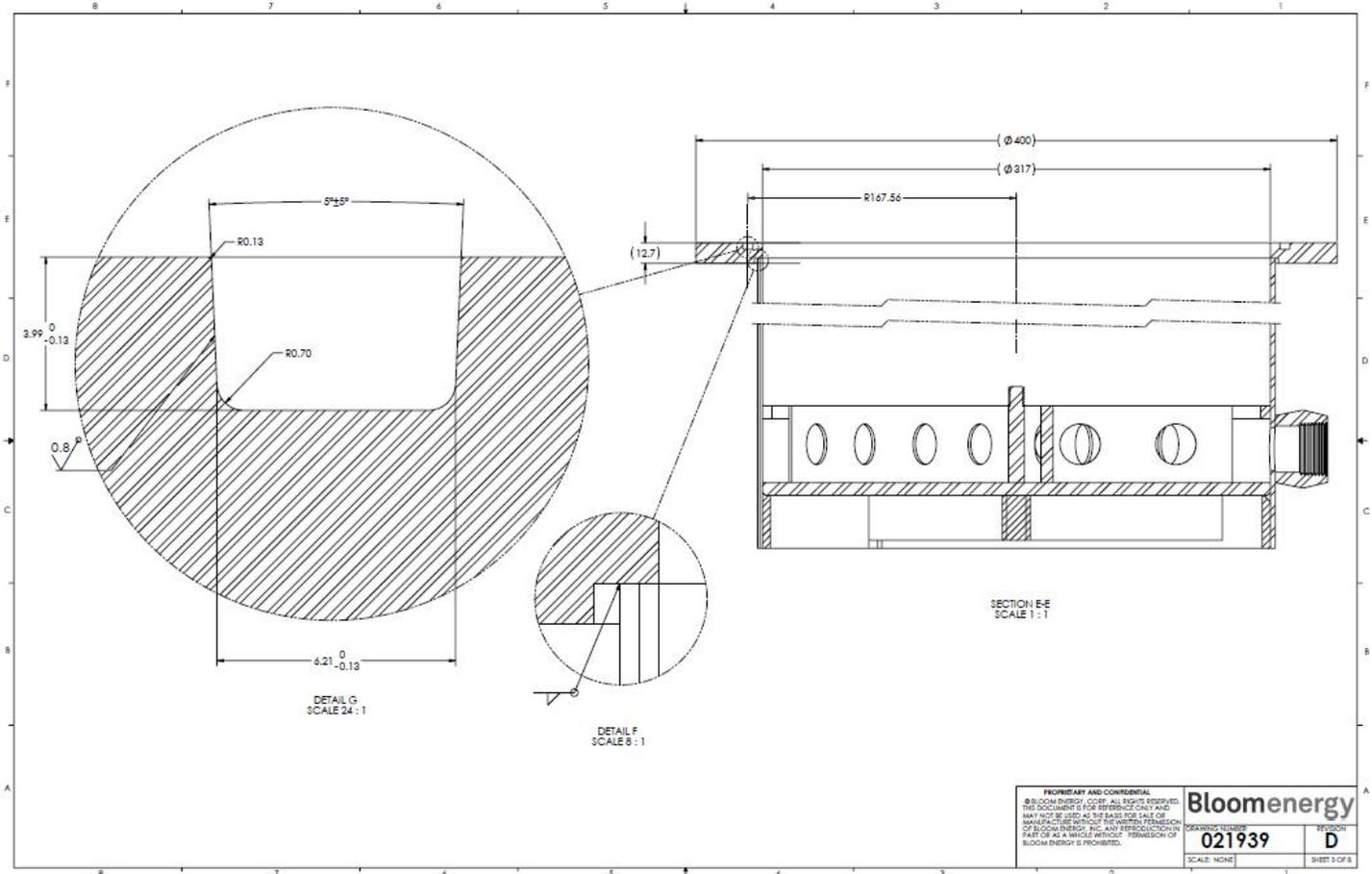


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Appendix E

Additional Information

Section II. Box / Bottle / Cap – Pictures/Drawings

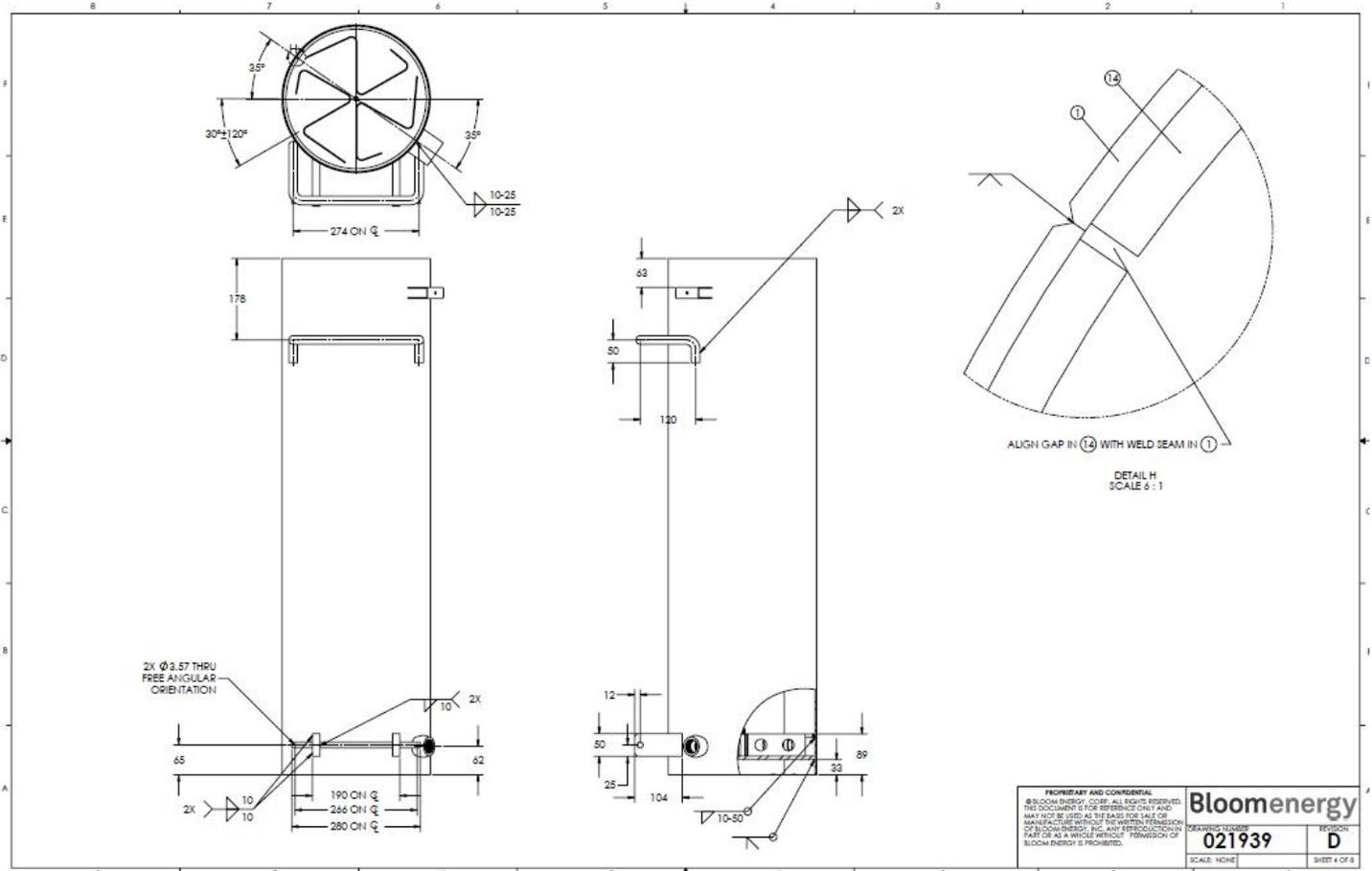


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Appendix E

Additional Information

Section II. Box / Bottle / Cap – Pictures/Drawings

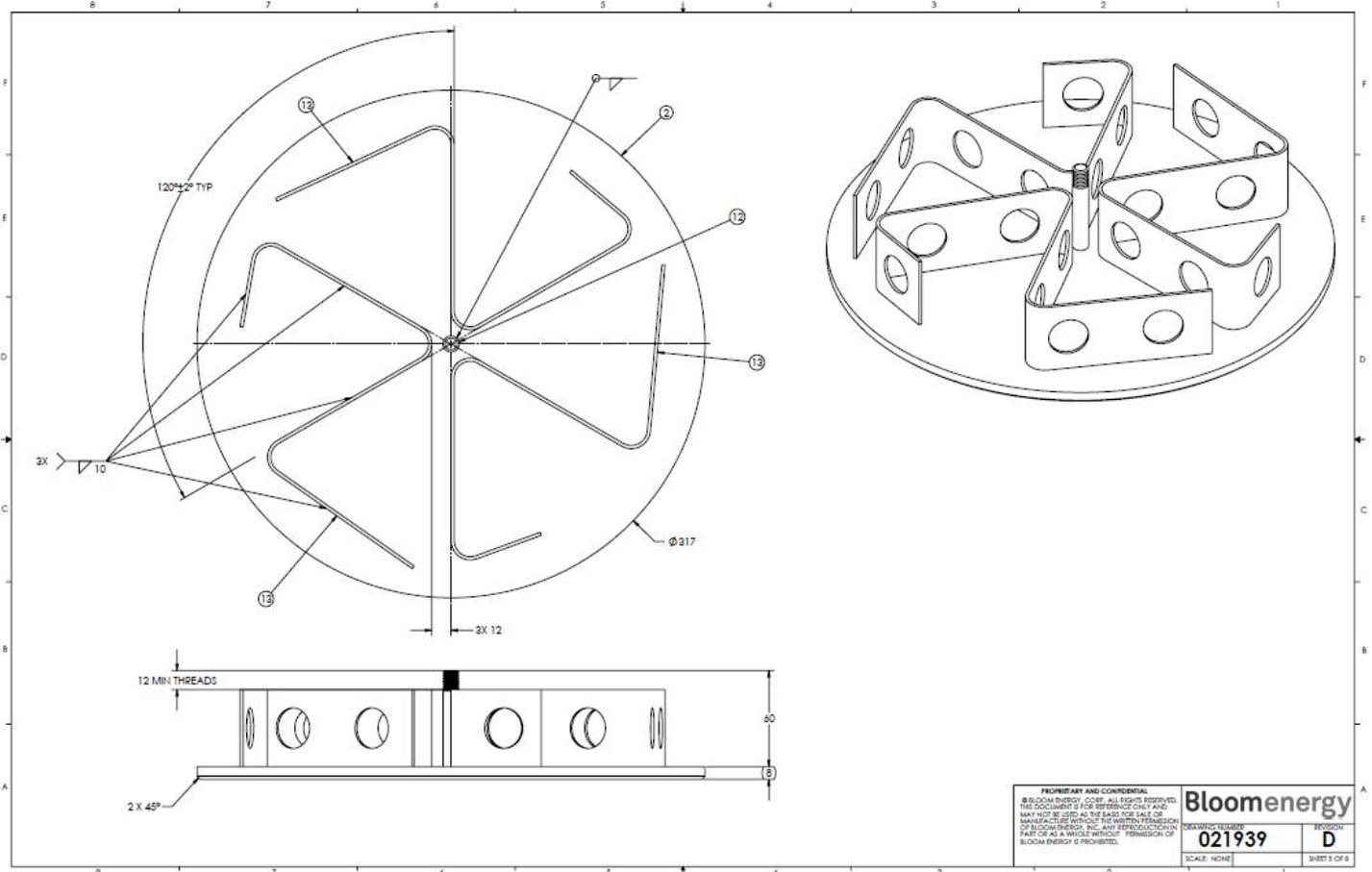


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Appendix E

Additional Information

Section II. Box / Bottle / Cap – Pictures/Drawings

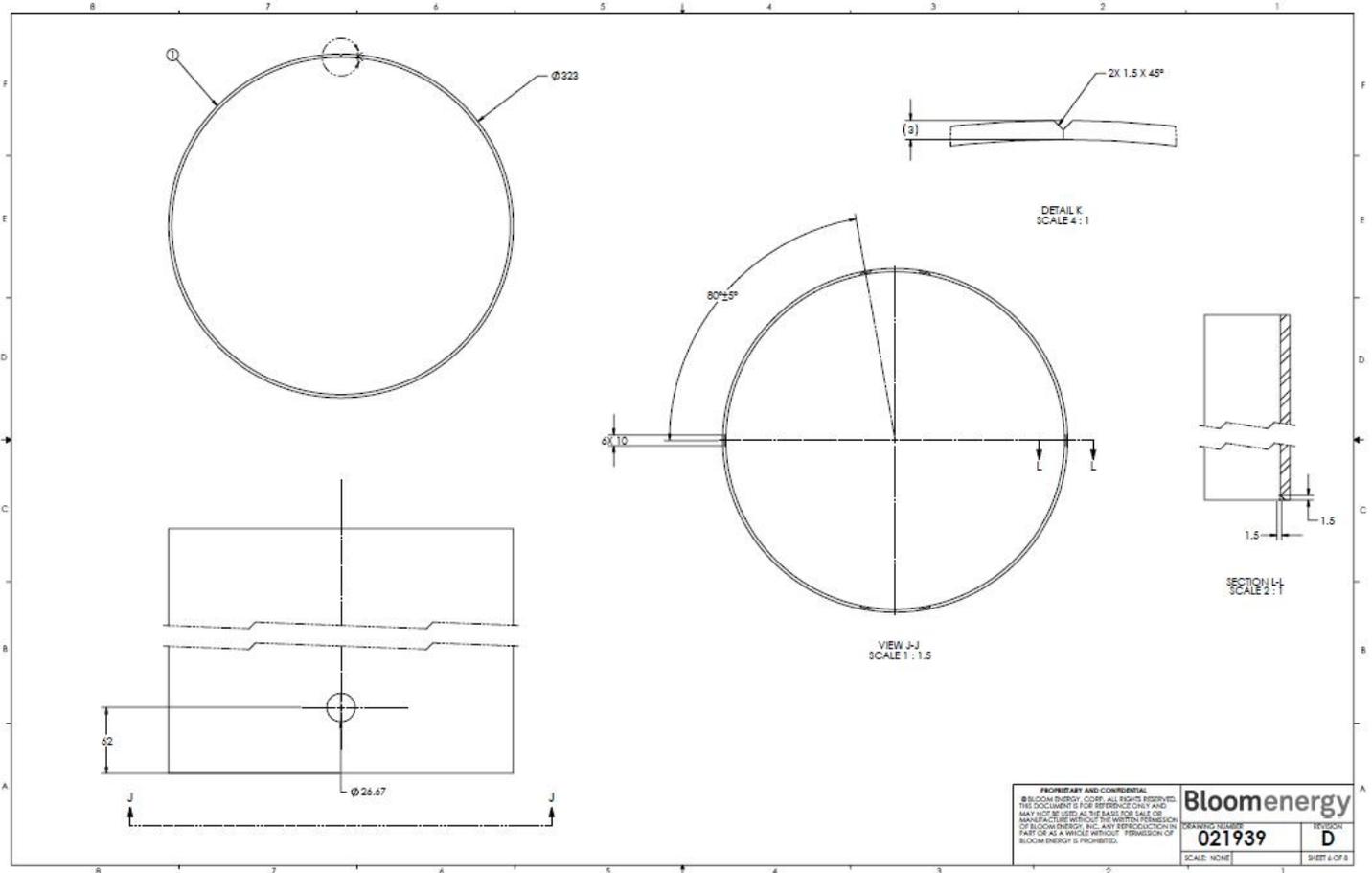


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Appendix E

Additional Information

Section II. Box / Bottle / Cap – Pictures/Drawings



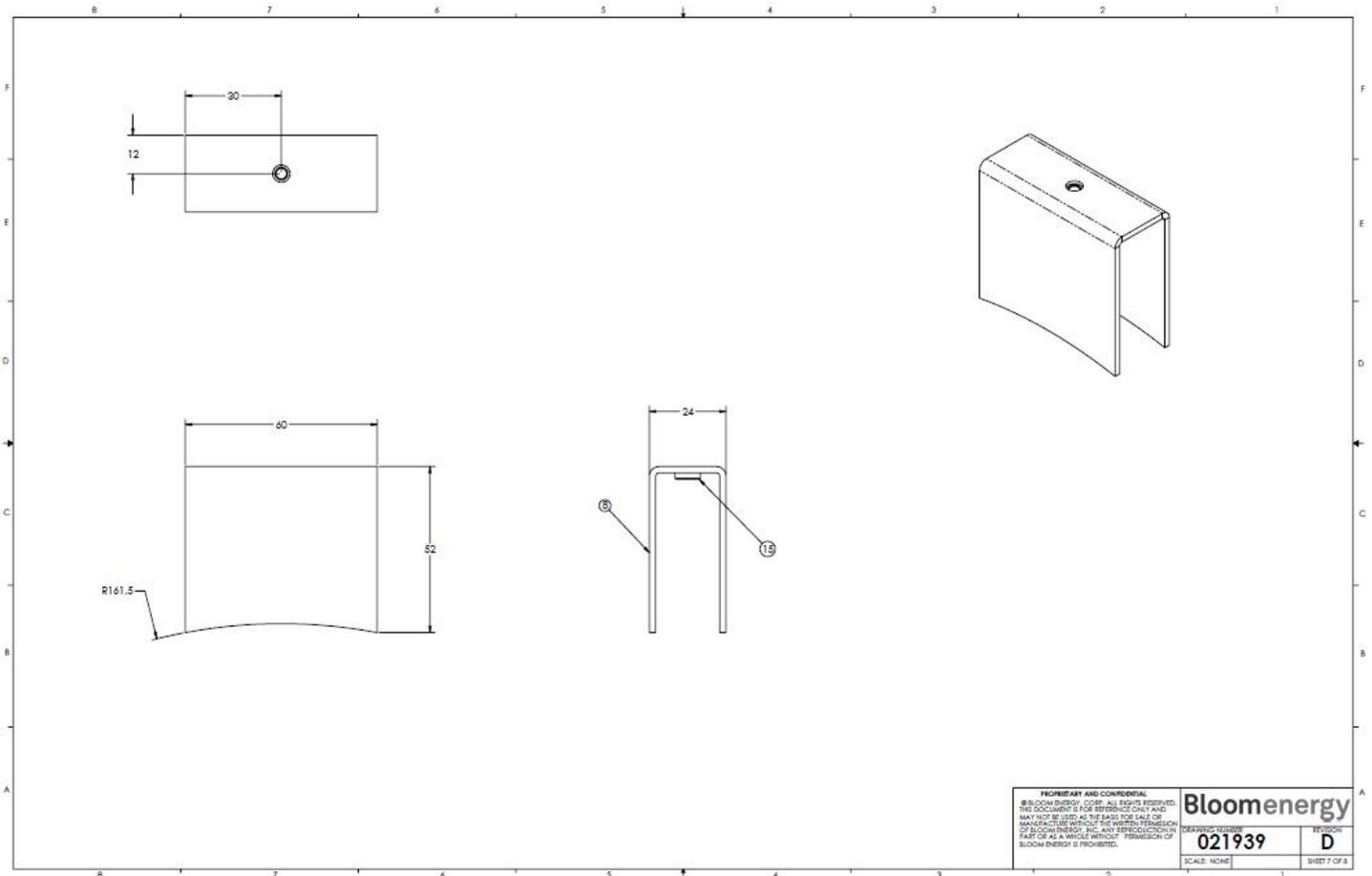
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Additional Information

Section II. Box / Bottle / Cap – Pictures/Drawings



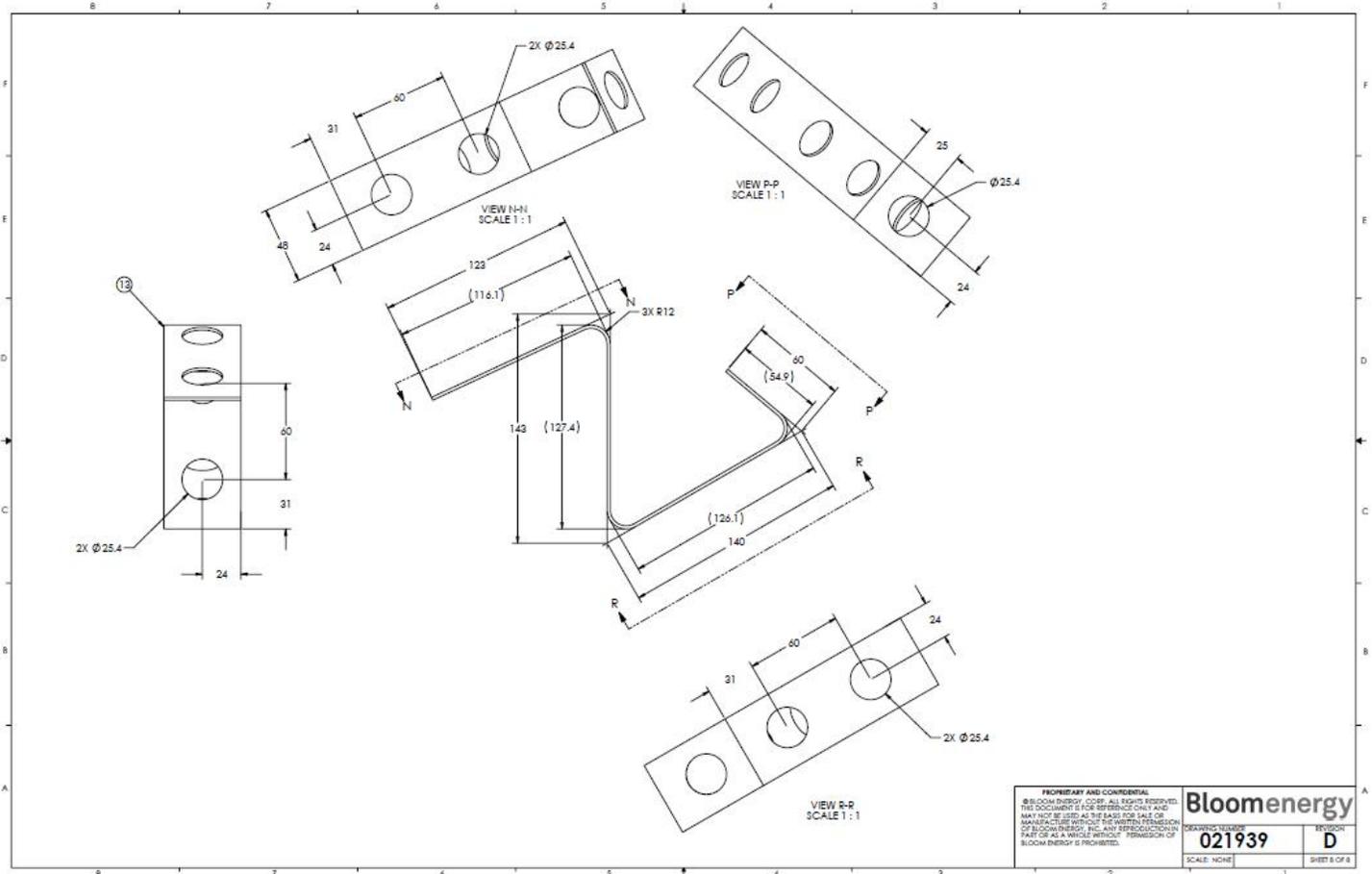
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<small>DESIGNATION NUMBER</small> 021939		<small>REVISION</small> D	
<small>SCALE: NONE</small>		<small>SHEET 7 OF 8</small>	

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Appendix E

Additional Information

Section II. Box / Bottle / Cap – Pictures/Drawings



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DRAWING NUMBER 021939		REVISION D	
SCALE: NONE		SHEET 8 OF 8	

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Appendix E

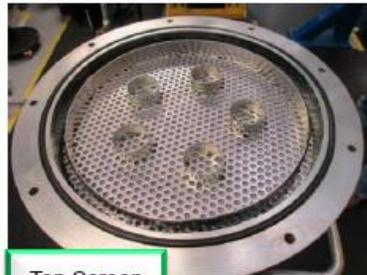
Additional Information

Section III. Closure Instructions

DOC-1005596 REV A

TUCSON CANISTER FILL (CLARIANT) Step 13 Install Top Screen, Springs and Top Lid

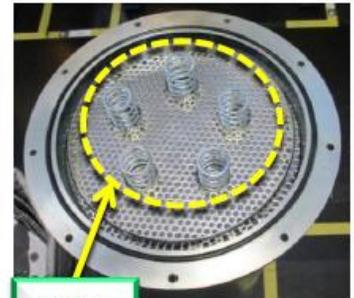
Place the top screen on top of the GS23	Top welded screen with mesh facing down and	▼
Install (5) springs on the fixture and verify that all have the correct size compare to the mark on the fixture and install all (5) into the spring slots. If they are smaller, dispose them to Quality	All (5) Springs are present in Canister and have the correct size	▼
Verify the sealing surfaces and the O-ring groove are free from damage, if damage is present contact the station lead	Top lid has a smooth surface and O-ring groove are free from damage and dust/debris	▼
Verify the O-ring is free from damage, if damage is present dispose it. Using an shop towel, clean and place the gasket O-ring into the canister flange groove	Gasket O-ring is free from damage (rips/tears), clean and above the top surface of the Canister	▼
Record the top screen and (5) springs installation on the Traveler	Activity recorded on Traveler	▼



Top Screen



Fixture



Springs

Appendix E

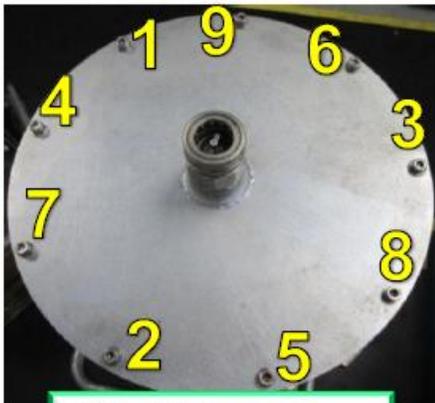
Additional Information

Section III. Closure Instructions

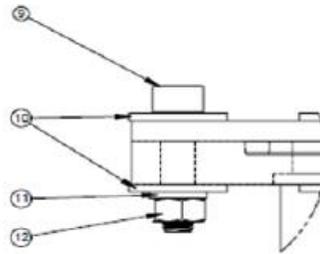
DOC-1005596 REV A

TUCSON CANISTER FILL (CLARIANT) Step 14 Install Top Lid

Torque the lid bolts to 25 Nm using a star pattern as in picture "A"; using the 25 Nm torque wrench with a 6MM hex bit and counter-torqueing using ½" wrench	All bolts are torqued to 25 Nm
Using a 25 Nm torque wrench, torque again all screws following sequence on picture "B" using the same 25Nm torque.	Screws torqued to 25 Nm



Picture "A" Torque sequence



- 9. M8 Bolt
- 10. M8 Flat washer
- 11. M8 Spring Lock Washer
- 12. M8 Nut



Picture "B" Torque sequence



(2) M8 Flat washer, M8 Spring Lock Washer, M8 Nut



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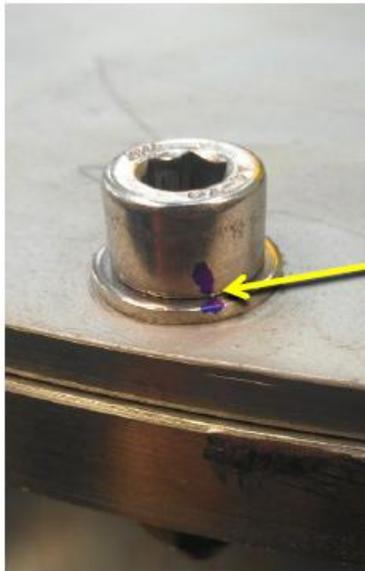
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Section III. Closure Instructions

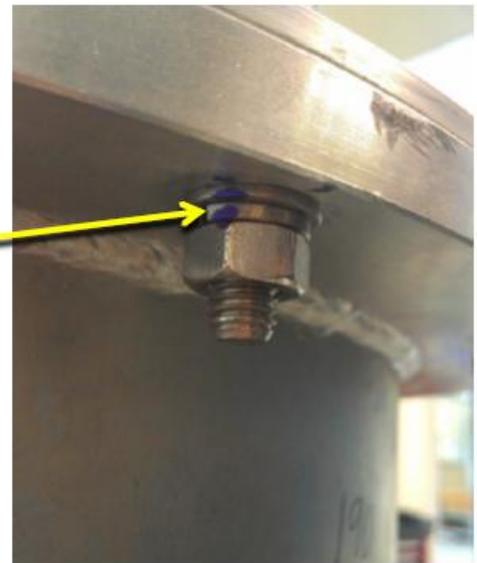
DOC-1005596 REV A

TUCSON CANISTER FILL (CLARIANT) Step 15 Install Top Lid

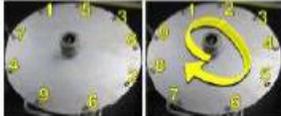
Record the torque on the Traveler	Torque recorded on Traveler 
Using a blue sharpie, apply a blue torque stripe to all (9) bolts, verify that all (19) flat washers and (9) lock washers are present and free from damage	Lock washers aligned with each bolt 's head and blue torque stripes present



Torque stripe present in top/bottom surfaces



Record on Traveler

<p>TOP BOLTS TORQUE 25Nm TORQUE EN TORNILLOS DE LA TAPA SUPERIOR A 25 Nm</p> 	<p>THE 9 TOP BOLTS WERE TORQUED TO 25 Nm AND THE SECUENCE WAS FOLLOWED? / FUERON TORQUEADOS LOS 9 TORNILLOS DE LA TAPA SUPERIOR A 25 Nm Y FUE SEGUIDA LA SECUENCIA?</p>
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